Examples of Achievement

Electronic Ballasts

The Division's lighting team worked with manufacturers to develop electronic ballasts, a more efficient replacement for the magnetic ballasts used to control the current in fluorescent lamps. Electronic ballasts now account for 32 percent of the market, saving hundreds of millions of dollars per year.

Low-Emissivity Coatings for Windows

In the 1980s, EETD researchers worked with window manufacturers to develop special "low emissivity" window coatings to reduce heat loss through windows. These windows, which reduce energy loss by 20 to 50 percent depending on the design, now account for more than half of the market and have saved billions of dollars in energy costs.

Information and Monitoring-Based Commissioning

During the mid-1990s the commercial buildings team deployed and evaluated high quality monitoring platforms to help understand how building operators can benefit from improved energy information. Monitoring-based commissioning is now a major utility-funded efficiency program in California and is being deployed throughout the U.S.

Building Energy Simulation

One of the Division's first projects, in the 1970s, was the development of a computer program to simulate the energy use of buildings based on prospective designs. Architecture and engineering firms use DOE-2 to increase the energy efficiency of their designs, saving an average of 20% of building energy use. In the 1990s, EETD researchers and colleagues combined DOE-2 with features of other building software programs, creating EnergyPlus—a more versatile, sophisticated model that has become the new de facto standard.

Energy Auditing for Consumers

In the first-ever such use of the Internet, a program called Home Energy Saver (HES) is available to anyone with web access (http://HES.lbl.gov). The user inputs information about a home, and HES (using DOE-2) calculates total energy use and cost, and suggests economic ways of reducing the energy bill. Since its beginnings in the late 1990s, Home Energy Saver has served more than a quarter of a million homeowners and apartment dwellers.

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Visit the Building Technologies Department, Environmental Energy Technologies Division:
http://eetd.lbl.gov/r-bldgsee.html

The mission of Berkeley Lab's Environmental Energy Technologies Division is to perform research and development leading to better energy technologies that reduce adverse energy-related environmental impacts. Our work increases the efficiency of energy use, reduces its environmental effects, provides the nation with environmental benefits, and helps developing nations achieve similar goals through technical advice.

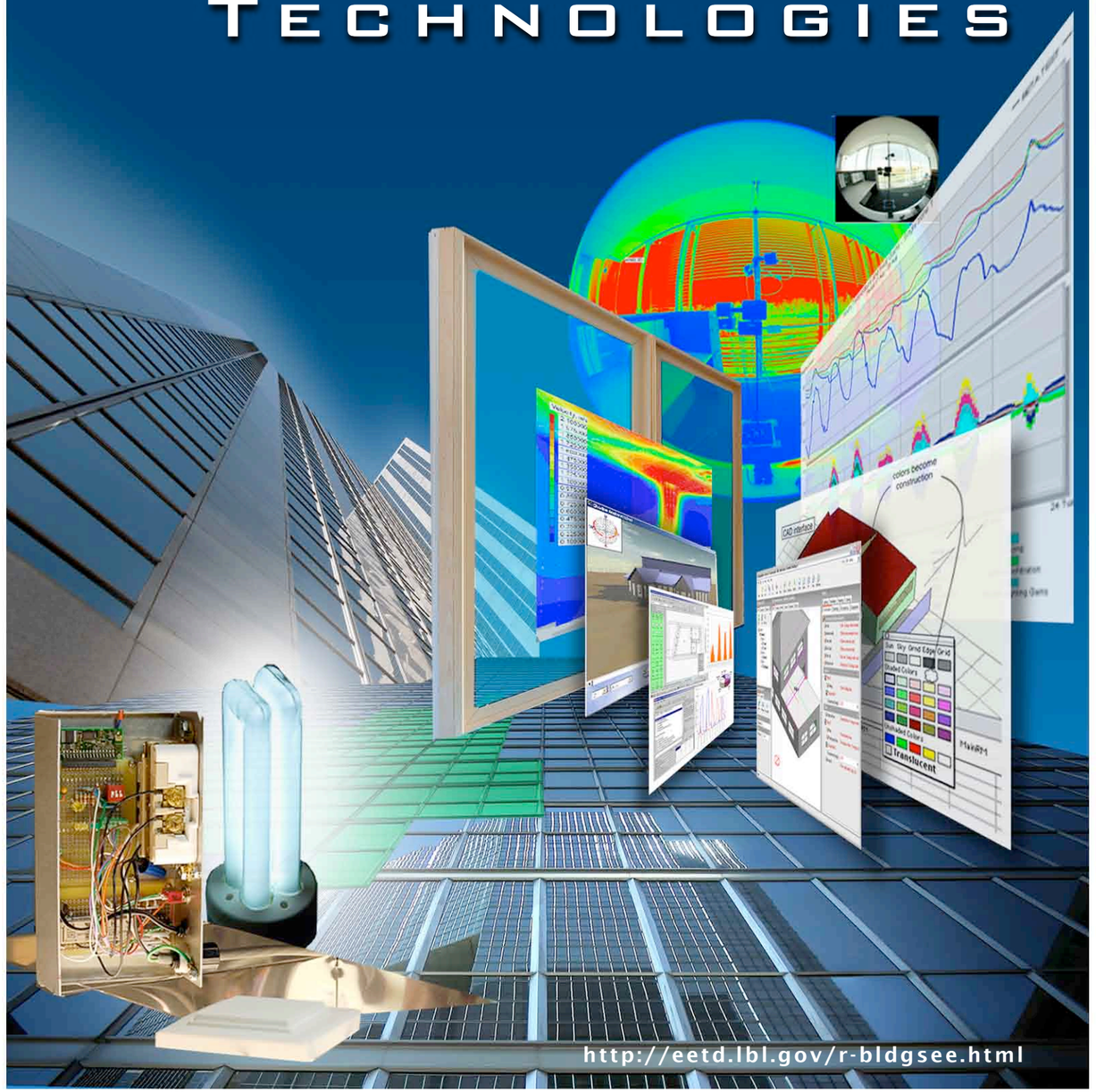
February, 2011

Lawrence Berkeley National Laboratory

Environmental Energy Technologies Division

2011

Building Technologies



Building Technologies Department

Buildings in the U.S. use 40 percent of U.S. energy and emit 40 percent of U.S. greenhouse gases. To reduce GHGs and counter climate change, it is necessary to develop methods that substantially reduce GHG emissions from buildings.

The goal of 21st century research on energy-efficient buildings is to develop design, construction, and operational technologies and practices that lead to the construction of net zero energy buildings (NZEBs). Those buildings will use 70 percent less energy than today's average, with the remaining energy use supplied by clean, sustainable energy sources. By 2030, every new building should be a net-zero energy building, by 2050, 50 percent of all existing buildings should be retrofit to this level.

Division researchers work closely with industry to develop efficient technologies for buildings that reduce energy bills while improving the comfort, health, productivity, and safety of building occupants.

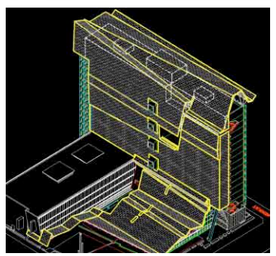
Our efforts focus on developing the following:

- A building operating platform that can be used to design and simulate net-zero energy buildings
- Simulation models and benchmarking tools to evaluate efficiency and whole building systems and components
- Whole-building and system diagnostics and energy information systems
- Advanced control systems and sensors for NZEBs
- Windows, daylighting, and lighting control systems
- Automated demand response communications and load-reduction technologies for the smart grid
- Energy-efficient high-technology buildings, including data centers, labs, and cleanrooms
- Demonstrations and deployment strategies of advanced commercial building systems through high-profile R&D partnerships

Research Areas

Commercial Buildings

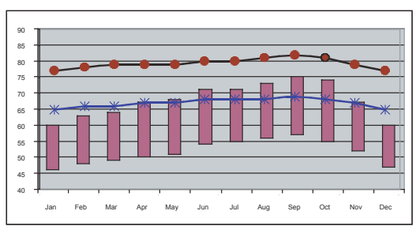
Advanced Commercial Building Systems and Simulation Research



Central to the goal of the net-zero energy building is developing the *Building Design and Operating Environment* that will allow architects and engineers to perform model-based system engineering for building design and operation. It consists of a *Building Design Platform,* a *Building Operating Platform,* and a supporting *Building Informatics Repository*.

The Building Design Platform generates design information that specifies the design and its corresponding energy performance. This information is used by the Building Operating Platform to configure the control system and test the implementation of algorithms used in various aspects of operation. The Building Informatics Repository will contain simulation tools, model libraries and algorithms for control and optimization that support both the Building Design Platform and the Building Operating Platform.

Under the platform, building operators will have access to information about how the building is designed to operate, as well as benchmarks to assess the day-to-day energy performance of their buildings, and to maximize energy efficiency and building comfort in real time—something that few facilities managers have today. Research to develop these software tools is in its early stages.



http://cbs.lbl.gov/
http://buildings.lbl.gov/

EnergyPlus

DOE Information Technology Quality Awards

R&D 100

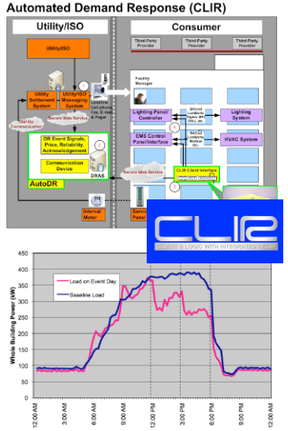
Buildings researchers at Berkeley Lab began developing a model to simulate the energy use of buildings in the 1970s. DOE-2 became the de facto standard in the buildings community. It has been superseded by EnergyPlus, which models heating, cooling, lighting, ventilating, and other energy flows as well as water in buildings, and whose development is also led by buildings researchers in the Division's Building Technologies Department. Originally based on the most popular features and capabilities of DOE-2 and other programs, EnergyPlus includes many innovative simulation capabilities, such as time steps of less than an hour, modular systems and plant integrated with heat balance-based zone simulation, multizone air flow, thermal comfort, water use, natural ventilation, and photovoltaic systems.

Demand Response

DRRC
Demand Response Research Center

PIER
PUBLIC INTEREST ENERGY RESEARCH
"Research Powers the Future"

Automated Demand Response (CLIR)



The Demand Response Research Center (DRRC) was launched at Berkeley Lab by the California Energy Commission's Public Interest Energy Research (PIER) Program in 2004 to support all forms of demand response R&D. The DRRC manages a portfolio of research projects that address demand response pricing, valuation, and behavior, as well as building-to-grid interfaces and technologies.

Demand response (DR) is the customer's process of managing electricity use dynamically upon receiving a notification from the electric utility or independent system operator (ISO) that indicates the grid is near capacity—for example, when too many air conditioners are on during a hot summer's day. Customers who enroll in a utility's DR program decrease their building's electricity usage by reducing lighting, cooling, or other loads. This reduction may last from 5 minutes to several hours, depending on the constraints of the grid.

Automating this process ensures timely and persistent participation. DRRC researchers have developed OpenADR, an open and interoperable automated communications platform that links the electric grid operations with a facility's energy management and control systems. Customers pre-program their energy management strategies for the DR period, and those strategies are dispatched upon the receipt of price, reliability, or emergency signals from the electricity grid.

Use of OpenADR is expanding in California, thanks to the California Public Utility Commission's interest and a partnership between the DRRC and California's investor-owned utilities. OpenADR has also been used in Seattle in coordination with Seattle City Light and the Bonneville Power Administration. The public specification known as "OpenADR Version 1.0" is being formalized in the National Institute of Standards and Technology (NIST) smart grid standards process. It is one of the key technologies to enable price- and reliability-based demand response for the U.S. and abroad.

http://drrc.lbl.gov

Commissioning, Fault Diagnostics, and Energy Information Systems

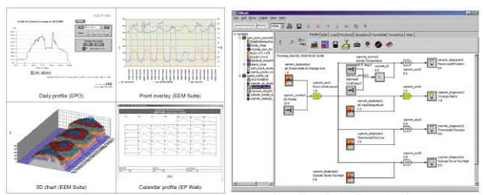


Figure 4-1. Time-series Visualization Examples

PowerVisor Facility Diagnostic Network

Energy is wasted in commercial buildings when equipment is not well controlled, maintained, scheduled, or calibrated. EETD researchers have developed tools, case studies, diagnostic methods, and energy information systems to help identify and reduce energy waste.

http://eis.lbl.gov